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Re: Stack Emission Study  
Centralized Refurbishing Center  
Elk Grove, Illinois

Exhaust stack emission studies from the solvent cleaning booths at the Elk Grove, Illinois Centralized Refurbishing Center were conducted September 5 and 6, 1972. These studies involved the collection of three one-hour air samples from each of two exhaust stacks on one of the two solvent cleaning exhaust booth lines. Each cleaning line has two booths of identical size and use. One booth has a ten foot wide opening, and the other booth has a twenty foot wide opening. In the discussion of the study these booths are referred to as line "A" and line "B", respectively.

The three one-hour samples from each line were collected and analyzed for the solvent hydrocarbon formula containing methylene chloride, trichloroethylene, perchloroethylene and mineral spirits. The solvent is labeled as AP-71. In addition, three one-hour samples from each line were collected for particulates, nitrogen

oxides and sulfur oxides. Carbon monoxide concentrations were determined by Kitagawa detector tubes once every fifteen minutes during sample collection. A one-hour general outdoor air sample was collected for the analysis of solvent vapor, particulates, nitrogen oxides and sulfur oxides. An outdoor test for carbon monoxide also was made.

The small booth stack, line A, measures thirty-four inches in diameter, and the large booth stack, line B, measures forty-two inches in diameter. These booths are normally vented by stub stacks mounted with caps. However, for the tests, the caps were removed, two 90° elbows with the same diameter were installed, and horizontal ductwork also was installed running across the room and supported by scaffolding. The two ducts of the same diameter were each extended for a distance of ten diameters downstream. Two sample ports in each duct were installed at 90° and at a point eight diameters downstream and two diameters upstream from the final elbow.

Velocity traverse studies were made using an "S" type Pitot tube and draft gage. These studies were made at both sampling ports using the equal area zone technique, and made again, using three inch centers. Velocity traverse figures were identical for both horizontal and vertical determination, and the results show a steady state flow condition across the diameters at the points of sampling. The velocity traverse data is shown in the tables, and the layout of the ductwork is shown in the print.

Air samples were collected at the equal area zone locations with continuous Pitot tube and draft gage monitoring during the sampling periods. Stainless steel nozzles and piping were used leading directly into glass collecting equipment. The solvent vapor samples were collected above a sixty millimeter diameter glass frit using a two inch high column of silica gel for collection.

The nitrogen oxides and sulfur oxides were collected in 150 ml. of N/50 NaOH (sodium hydroxide) in large impingers. Following glass collection equipment, any water vapor was trapped in a large impinger. Only negligible amounts of water vapor were found in any of the samples collected. A Rockwell dry gas meter was used in connection with a pump and motor. Meter temperatures were 72°F. The principles of the Federal EPA test procedures were followed.

Stack data together with sample times are shown. The sample was interrupted in case of lunch break or coffee break. It was determined that there occurs approximately fifty minutes of no solvent use during an eight-hour shift. Total solvent use for all four exhaust booths was 77.4 gallons during the one hundred eighty minutes of sampling time. This determination was based on actual meter readings on the solvent supply line for the cleaning room. This data is reported in the tables.

The time of sampling for the particulate and gas emission study, September 6, 1972, also is shown in the tables. Only the solvent sampling study was conducted on September 5, 1972. The stack data reported for that date is consistent with the conditions of sampling on September 6, 1972.

#### ANALYTICAL PROCEDURES

The analysis for solvents was carried out on a Fisher Victor-  
een Model 4400 gas chromatograph with flame ionization detector. The column was filled with 20% Carbowax x 20M on firebrick 60/80 mesh. Carrier gas was nitrogen. Dimethylsulfoxide was used as the eluant for removal of the sample from the gel. All preparation and other instrumental parameters were as set forth in a paper, "The Use of Silica Gel in Source Testing", by M. Feldstein, et al, AIHA Journal, Volume 28, Number 4, July-August, 1967, pp 381-385. Confirmation of results by the above procedure was made with another eluant, carbon disulfide, as recommended in another paper, "Determination of Halogenated and Aromatic Hydrocarbons in Air by Charcoal Tube and Gas Chromatography" by Frank H. Reid and Walter R. Halpin, AIHA Journal Vol. 29, Number 4, July-August, 1968, pp 390-396.

All air samples were collected isokinetically with the exception of the one-hour outdoor sample, and the carbon monoxide samples. The samples for particulates were lead through a 1/4" nozzle directly into a stainless steel filter paper holder. The filter

paper was a 47 millimeter size triacetate metricel, type GA-6, as manufactured by Gelman Instrument Company. The filter paper has a mean flow pore size of 0.45 microns. The pre-weighed filter was oven dried, cooled, and re-weighed for the analysis of each particulate by weight. Sulfur oxide samples were analyzed by the West, P. W. and G. C. Gaeke technique, Fixation of Sulfur Dioxide as Disulfitomercurate and Subsequent Colorimetric Estimation. Anal. Chem. 28: 1816 (1956). The nitrogen oxides were analyzed by the Phenoldisulfonic Acid Method: Analytical Chemistry of Industrial Poisons, Hazards and Solvents, M. B. Jacobs, Interscience Publishers, New York.

The outdoor air sample was collected upwind of the exhaust stacks at the corner of the roof, for a period of one hour at 1 CFM, using silica gel as a collection media.

#### RESULTS OF STUDY

It has been determined that in the use of solvent formula AP-71 in the cleaning booths at the Centralized Refurbishing Center of Xerox Corporation, Elk Grove, Illinois, there is no emission of photo-reactant chemicals in concentration that would exceed the forty pounds per day limit. The only photo-reactant chemical determined to be emitted is trichloroethylene in a concentration of 0.7 pounds per hour. The total solvent vapor emission from the

cleaning room, four booths, has been determined to be 7.42 pounds per hour. The per cent of ingredients in the vapor phase is approximately as follows:

AP-71 Per Cent Ingredients in Vapor

Methylene Chloride	14%
Trichloroethylene	10%
Perchloroethylene	26%
Mineral Spirits	50%

Aeromatic hydrocarbons were found to be in extreme trace concentration, less than 0.1% of the total solvent vapor. No other photo-reactant chemicals were found. No ethyl benzene, ketone, or toluene was found.

No sulfur oxides or nitrogen oxides were found. Only trace quantities of particulates were determined to be present in the exhaust from the solvent cleaning room. The concentration at most reached only one gram per hour from one stack, and only three grams per hour from all four stacks of the cleaning department.

In summary, it has been determined that no air pollution problem exists in the operation of the cleaning department of the Centralized Refurbishing Center with respect to solvent vapor, particulates, sulfur oxides, nitrogen oxides, or carbon monoxide.

WRB:lw

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SOLVENT USE

9-5-72

<u>Time</u>	<u>Meter Reading Gallons</u>
10:30 AM	1064.8
12:16 PM	1079.1
2:13 PM	1142.5
<u>3:13 PM</u>	<u>1163.5</u>

Total time 283 min. = 98.7 gal.

Down time 50 min.

Solvent use time 233 min. = 98.7 gal.

Solvent use 180 min. = 77.4 gal.

Plant Operating Schedule

Begin shift	7:00 AM
Coffee break	9:15-9:30
Lunch	11:25-12:00
Coffee break	2:15-2:30
End shift	3:00 PM

Total solvent use = 25.8 gal./hr. (average)

= 219 lb./hr. (average)

RESULTS OF ANALYSIS

	mg	in	sample	
<u>Sample Description</u>	<u>Methylene Chloride</u>	<u>Trichloro-ethylene</u>	<u>Perchloro-ethylene</u>	<u>Mineral Spirits</u>
1 hr. - Line A #1	1.94	1.51	2.77	6.22
1 hr. - Line A #2	3.16	2.45	4.80	10.41
1 hr. - Line A #3	1.41	0.39	1.10	2.90
1 hr. - Line B #1	5.00	3.14	9.94	18.08
1 hr. - Line B #2	10.48	9.31	23.76	43.55
1 hr. - Line B #3	4.88	1.90	7.13	13.91
1 hr. - Outdoor Chicago	0.026	0.10	0.241	0.367

SOLVENT VAPOR EMISSION

	gm.	per	hour	
1 hr. - Line A #1	40	31	57	128 .
1 hr. - Line A #2	65	50	100	215 .
1 hr. - Line A #3	29	8	23	60 .
1 hr. - Line B #1	138	86	275	500 .
1 hr. - Line B #2	289	257	658	1203
1 hr. - Line B #3	<u>135</u>	<u>52</u>	<u>197</u>	<u>384</u>
Total gm./hr.	696	484	1130	2490

SUMMARY - SOLVENT VAPOR EMISSION

	<u>Gm./3 hrs.</u>	<u>Lb./3 hrs.</u>	<u>Lb./hr.</u>
Methylene Chloride	696	1.53	0.51
Trichloroethylene	484	1.06	0.35
Perchloroethylene	1310	3.00	1.00
Mineral Spirits <i>Naptha</i>	2490	5.59	<u>1.85</u>
			3.71

Total emission from one solvent cleaning line = 3.71 lb./hr.

Total emission from plant (2 cleaning lines) - 7.42 lb./hr.

Total photoreactive solvent (trichloroethylene) emission from both cleaning lines per hour = 0.7 lb./hr.

AP-71 PER CENT INGREDIENTS IN VAPOR

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Trichloroethylene	10%
Perchloroethylene	26%
Mineral Spirits	50%